DOCUMENT RESUME

ED 436 166 IR 019 791

AUTHOR Chiero, Robin T.
TITLE Secondary Teachers' Professional Uses of Computers.
PUB DATE 1999-02-00
NOTE 10p.; In: Proceedings of Selected Research and Development Papers Presented at the National Convention of the Association for Educational Communications and Technology [AECT] (21st, Houston, TX, February 10-14, 1999); see IR 019 753. Figure 1 is illegible.
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Uses in Education; Interviews; Secondary Education; *Secondary School Teachers; Tables (Data); *Teacher Attitudes; Teacher Characteristics; Teacher Surveys; Use Studies
IDENTIFIERS Barriers to Implementation; Computer Users; Facilitators; *Technology Integration; *Technology Role

ABSTRACT

The purpose of this study was to investigate teachers' perceptions of the role computers play in their workplace performance. Subjects were 142 secondary public school teachers who responded to a 71-item questionnaire. Follow-up telephone interviews were conducted with 15 carefully selected subjects to provide more depth. Data were analyzed to provide a multifaceted description of teachers' current professional computer uses, their perceptions of the effects of the computer on their work, and what most facilitates or impedes their computer use. Subjects generally use the computer for typical tasks, such as creating instructional materials and performing administrative tasks. Most perceived their computer use as having a positive impact on their work, making them more professional, more creative, better informed, and generally better educators. Surprisingly, improved interaction with colleagues did not emerge as a particularly important use of the computer. Accessibility to e-mail and Internet access was moderate or high for only 33.8% of the subjects, and few use the computer to communicate with colleagues, a use that might ease the isolation of teachers and foster professional development. (Author/MES)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 436 166

Secondary Teachers' Professional Uses of Computers

PERMISSION TO REPRODUCE AND
DISSEMINATE THIS MATERIAL
HAS BEEN GRANTED BY

S. Zenor

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

By:

Robin T. Chiero, PhD.

IR019791

BEST COPY AVAILABLE

SECONDARY TEACHERS' PROFESSIONAL USES OF COMPUTERS

Robin T. Chiero, PhD.
California State University, Fresno

The purpose of the study described in this paper was to investigate teachers' perceptions of the role computers play in their workplace performance. Subjects were 142 secondary public school teacher who responded to a 71-item questionnaire. Follow-up telephone interviews were conducted with 15 carefully selected subjects to provide more depth. Data were analyzed to provide a multifaceted description of teachers' current professional computer uses, their perceptions of the effects of the computer on their work, and what most facilitates or impedes their computer use. Subjects generally use the computer for typical tasks, such as creating instructional materials and performing administrative tasks. Most perceived their computer use as having a positive impact on their work, making them more professional, more creative, better informed, and generally better educators. Surprisingly, improved interaction with colleagues did not emerge as a particularly important use of the computer. Accessibility to e-mail and Internet access was moderate or high for only 33.8% of the subjects and few use the computer to communicate with colleagues, a use that might ease the isolation of teachers and foster professional development.

Introduction

"As state after state has to re-create schools so that they can meet 21st century demands, it has become apparent that their success depends fundamentally on teachers. What teachers know and can do is the most important influence on what students can learn" (The National Commission on Teaching and America's Future, 1996, p. 2). How teachers go about accomplishing their daily tasks influences their current effectiveness and their continuing improvement. There are currently concerns regarding the performance of teachers (The National Commission on Teaching & America's Future, 1996) and acknowledgment of the increasing importance of teaching-related tasks in addition to classroom instruction (Hargreaves, 1994). Despite empirical support that computer use improves teacher productivity (Rockman, Pershing, & Ware, 1992) and increases feelings of professionalism and effectiveness (Wilson, Hamilton, Reslow, & Cyr, 1994), there is limited research that focuses on how teachers are integrating computer practices to accomplish the many aspects of their work.

The purpose of this study was to expand the knowledge base concerning secondary teachers' perceptions of computer integration into their work, the effects of computer practices on their work, and what most facilitates or impedes their effective computer use. This knowledge base provides a foundation for further investigation of ways in which the computer might support teachers' efficiency and effectiveness on the job.

Conceptual Framework

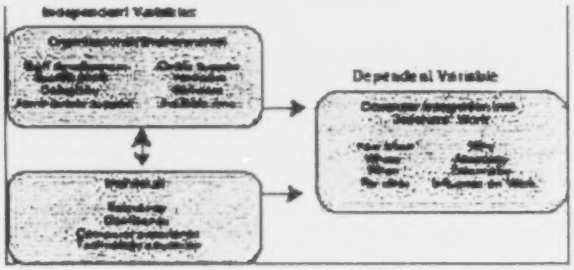
Critical to investigating teachers' professional computer use is capturing the essence of the meaning of *computer integration* in the context of teachers' professional activities. This exploratory study incorporated a comprehensive approach, conceptualizing computer integration as a multidimensional phenomenon. It used a framework based on sociotechnical systems theory and informed by other human performance models from the organizational development literature as the basis for identifying the individual, organizational, and environmental factors that might influence teachers' professional uses of computers. The sociotechnical systems framework also complements and extends other conceptual frameworks in the literature on teachers' work and on computers for educational purposes.

Variables Used in the Study

The dependent variable in the study was teachers' integration of computers into their day to day work. A major focus of the study was to identify and investigate the many facets of this variable. Eight a priori dimensions suggested by results of research on computers in educational and other organizational contexts were used to provide a learner and more complete measure of the dependent variable.

The independent variables were the facilitators of and barriers to computer use. A range of individual, organizational, and environmental factors consistent with sociotechnical systems theory and empirically supported in research on computers in education were included. Figure 1 shows the independent variables and the dimensions of the dependent variable.

Figure 1. Variables used in the study



Review of Relevant Literature

A study to identify and investigate the dimensions that provide a comprehensive picture of teachers' professional uses of computers draws from the literature in a variety of areas, including the occupation of teaching, the integration of integration into both educational and organizational contexts, and the analysis and improvement of workplace performance.

Measuring Computer Integration

Prior educational research on computer integration, although primarily emphasizing instructional uses and curriculum integration provides useful and relevant information that serves as a springboard to this study. Many studies have used a single measure to operationalize computer integration into educational settings. Measures among the studies vary and include frequency (Pelgrum & Plomp, 1991; Zammit, 1992), continuums or levels (Carrol & Perin, 1994; Marcinkiewicz, 1993-94; Moersch, 1995), developmental stages (Baker, Gearhart, & Herman, 1993), and styles of use (Evans-Andris, 1995).

A more comprehensive approach to conceptualizing computer integration is not without precedent, however. For example, to describe exemplary computer using teachers Hadley and Sheingold (1993) proposed a variety of profiles, and Becker (1994) suggested an index based on five components.

Dimensions of Teachers' Professional Uses of Computers

Because teachers routinely perform a wide variety of tasks, identifying the activities for which they use the computer is an important dimension. Reynolds (1992) found that middle school teachers spend one half of their time on tasks directly related to instruction. The other half of their workday is spent on other tasks, such as planning and preparing for instruction (20 percent), evaluating student learning and instructional effectiveness (15 percent), and administrative responsibilities and professional development (15 percent). Results of studies (Reynolds, 1992; Rosenfeld, Reynolds, & Bukatko, 1992; Shedd & Bacharach, 1991) have categorized teaching responsibilities and substantiated the notion that teaching involves a wide variety of complex tasks.

The notion of whether teachers consider their use of the computer essential to their day-to-day work is another dimension of computer integration. According to Carr (1992) one of the characteristics that describe a task is the value it adds. A task can directly add value, be ancillary to tasks that add value, indirectly add value, or be wasteful. The degree to which a task directly adds value is related to its essentiality. Researchers studying computers in the schools generally conceptualize integration as use for tasks that are critical to successful teaching (Becker, 1994). Results of studies often indicate that use for such consequential activities is not prevalent (Hadley & Sheingold, 1993; Marcinkiewicz, 1993-94).

The literature on technology in organizations other than schools provides valuable insights into a variety of reasons for using computers in the workplace and the potential impact of the computer on humans and work. Perspectives on the purposes for using computers range from improving efficiency to expanding human capacity by providing expertise, advice, and external storage of information. Zuboff (1988) envisioned two possible scenarios for companies integrating smart machines into the workplace. In the first scenario, which she termed *automate*, the intelligence was located in the smart machine at the expense of the human capacity for critical judgment. In the second scenario, termed *informate*, smart machines create the need for new skills and knowledge to exploit the potential of these technologies.

Sociotechnical Systems Theory and Computer Integration

Sociotechnical systems theory stresses the importance of both the requirements of the job and the organizational culture. According to this theory, job performance is a function of an appropriate combination of the technical requirements of the job and the social and psychological needs of the people (Pasmore, 1988; Trist, 1993).

BEST COPY AVAILABLE

Schein (1994) examined his research into the dynamics of organizational culture and concluded that a sociotechnical model is necessary to understand what really goes on in organizational domains and to arrive at better concepts and theoretical insights into the characteristics that support the introduction of information technology. Hart (1995) examined the implementation of technological innovations in education and asserted that "the slow integration of technology into schools despite large infusions of resources into hardware and software may in part have resulted from a failure to recognize the sociotechnical nature of these innovations " (p. 188).

Facilitators and Barriers to Computer Integration

The influence of social and psychological needs on workplace performance is consistent with research that indicates the importance of collegiality in the implementation of innovations in the schools (McLaughlin, 1993). Additional factors influencing the implementation of technology in school settings are summarized in Table 1. Empirical support is provided by studies in which results suggested the significance of the factor as a facilitator or barrier to computer use.

Table 1. Summary of Facilitators and Barriers Identified in Studies of Computer Use

	Empirical Support						
Facilitator/ Barrier	Becker (1994)	Hadley & Sheingold (1993)	Hart (1995)	Pelgrum & Plomp (1991)	Marcinkiewicz (1993-94)	Rockman, et al. (1992)	Bacharach, et al. (1986)
Time	X	X	X	X			X
Staff development	X	X		X		X	
Hardware, software availability	X	X		X			
Onsite Support	X	X		X		X	X
Administrator Support		X	X			X	
Specific goals				X			
Group Values/Collegiality	X	X	X			X	
Confidence/ Perceived expertise		X		X	X		
Relevance				X			
Technology Education	X	X					
Computer experience	X	X		X	X		

Method

The study used both quantitative and qualitative data. Quantitative data were collected from a survey administered to secondary public school teachers. Subjects in the study were 142 middle and high school public school teachers at ten schools in a single district. Random sampling was not used. Surveys were distributed to all secondary teachers in the district. The district recently developed and is beginning to implement a technology plan.

Survey Instrument

The survey consisted of 78 items which measured the eight a priori dimensions of computer integration, facilitators and barriers, individual characteristics, and demographic information. Answers were primarily in the form of Likert-type responses or multiple choice, with a few short-answer questions.

Teaching tasks included were based on the literature on teaching, particularly Reynolds (1992), and from the questionnaire used by Rockman, et al. (1992). Items to measure reasons for using the computer were based on previous studies (Rockman, et al., 1992; Hadley & Sheingold, 1993; Pelgrum & Plomp, 1992). Resources and barriers were consistent with sociotechnical systems theory as well as with prior research on computer integration in education. The instrument was revised several times based on comments from various educators. It was pretested using six middle-school classroom teachers. A final revision incorporated their comments.

Data Collection

A copy of the survey was distributed to 410 teachers at ten schools. Of this total, 142 (34%) were returned. Participation was voluntary and responses confidential. Because of unanticipated administrator concern, follow-up reminders were not sent.

The 67 respondents who indicated they were willing to participate in a follow-up telephone interview were grouped into four categories: (1) infrequent use and low expertise; (2) frequent use and low expertise; (3) infrequent

use and high expertise; and (4) frequent use and high expertise. Four subjects were interviewed from groups two through four and three individuals were interviewed from group one.

Data Analysis

Frequency distributions provided descriptive information on demographics, on the eight dimensions of computer integration, and on facilitators and barriers. Multiple regression analyses were used to provide information regarding combinations of facilitators and barriers that predict two aspects of computer integration, frequency of use and essentiality.

Results

Demographic Information

Of the 142 individuals who completed the questionnaire, 58.5% were female and 41.5% were male. Ages ranged from 25 to 71 years with an average age of 43.26 years. The number of years of teaching experience ranged from one to 46 years with an average of 16.13 years. The average number of years of experience using the computer was 7.3 years with a range of from zero to 29 years.

Most subjects had access to a computer both at school and at home, but had limited electronic mail and Internet access, as evidenced by the 66.2% of subjects who rated the availability of these resources as none or low. When asked how they would rate their overall computer expertise, 23.2% rated themselves nonusers or novices, 40.8% said they had moderate expertise, and 35.9% rated themselves as above average or experienced.

Dimensions of Computer Integration

Three-fourths of the subjects (75.4%) used the computer for work at least two to three times a week; 45.1% used it daily. Subjects who use the computer do so both at school (79% during prep time and 84.3% before or after class and at school (69.3% evenings or weekends and 58.5% during vacation periods). A majority (52.9%) of the subjects indicated that they routinely use the computer to create instructional materials A majority did not use the computer for two of the tasks, interacting with colleagues (52.5%) and analyzing the effectiveness of specific lessons.

When asked to rate how essential computers are to their work, 48.6% of the subjects indicated that they couldn't imagine doing their job without it. At the other end of the spectrum, 8.5% said that they would do just as well without it. Respondents also rated how essential they considered the computer for specific teaching tasks. Table 2 shows responses from highest (essential) to lowest (not important) mean score.

Table 2. Essentiality of the Computer for Specified Tasks

Activity	Not Important N (%)	Somewhat Important N (%)	Important N (%)	Essential N (%)	Mean
Instructional materials (N=127)	8 (6.3)	19 (15.0)	47 (37.0)	53 (41.7)	3.142
Administrative tasks (N=122)	16 (13.1)	14 (11.5)	39 (32.0)	53 (43.4)	3.057
Develop units/lessons (N=126)	16 (12.7)	23 (18.3)	43 (34.1)	44 (34.9)	2.913
Gather information (N=123)	20 (16.3)	28 (22.8)	44 (35.8)	31 (25.2)	2.699
Professional growth (N=120)	24 (19.7)	25 (20.5)	37 (30.3)	36 (29.5)	2.697
Monitor, assess learning (N=125)	26 (20.8)	27 (21.6)	34 (27.2)	38 (30.4)	2.672
Present lessons (N=119)	32 (26.9)	31 (26.1)	37 (31.1)	19 (16.0)	2.361
Interact with colleagues (N=120)	46 (38.3)	26 (21.7)	27 (22.5)	21 (17.5)	2.192
Analyze lesson effectiveness (N=116)	59 (50.9)	23 (19.8)	20 (17.2)	14 (12.1)	1.905

Of the 101 who responded to the item which asked them to indicate a single activity they would fight for if they were limited to only one computer activity, the largest number (29) listed word processing followed by record-keeping (28) and grading (23). Interview subjects would give a high priority to technology if they were in charge of allocating financial resources, although most hesitated to name it number one. Those interviewed mentioned other important competing needs, for example, "right now we'd love to have air conditioning." Another commented that the school, which used to be an elementary school, was in need of a gym. The teacher continued, "I'd rather have smaller classes than computers. I'd chuck my computers for smaller classes."

Teachers surveyed were asked to rate the importance of eight reasons for using the computer. Table 3 shows the distribution of responses from highest (very important) to lowest (not important) mean score.

BEST COPY AVAILABLE

Table 3. Importance of Reasons for Using the Computer

Reason	Not important N (%)	Somewhat important N (%)	Very important N (%)	Mean
I can create more effective materials.	11 (7.7)	27 (19)	104 (73.2)	2.65
It saves time.	10 (7.1)	31 (22)	100 (70.9)	2.63
I can keep better track of student performance and records.	38 (27)	35 (24.8)	68 (48.2)	2.21
I can use the Internet to access information & ideas.	46 (32.6)	39 (27.7)	56 (39.7)	2.07
It can help me do things I don't currently know how to do very well.	47 (33.1)	59 (51.5)	36 (25.4)	1.92
It helps me find valuable information on students.	63 (45)	39 (27.9)	38 (27.1)	1.82
I can communicate and collaborate with others regardless of where they are.	67 (47.2)	42 (29.6)	33 (23.2)	1.76
I get lots of ideas and help from other teachers.	61 (43.6)	57 (40.7)	22 (15.7)	1.72

When asked to rate various ways in which using the computer might influence their own work, a majority of subjects agreed or agreed strongly that they were more productive (76.7%), more professional (72.3%), more creative (66%), better informed (54.7%), and generally better educators (60.6%) as a result of their computer use. Only 31.4% agreed or agreed strongly that they have more time with students and 21.5% that they collaborate more with other teachers.

Subjects who were interviewed responded positively when asked for their general opinion about computers and their work. One subject did describe them as a "mixed blessing" and another responded "I love them for what I use them for. I don't care about techie stuff." One teacher mentioned a change in attitude over the last seven years. "I first refused to use them because I didn't know how. The kids used them so I had to learn." Another mentioned the importance of being a role model. "For the kids to see me use the computer a lot encourages them to use it. They appeal to kids I would feel handicapped without one."

Facilitators and Barriers to Teachers' Computer Integration

Availability of specified resources was rated either moderate or high by a majority of respondents except for three: (1) release time to observe examples (17.1 %); (2) E-mail and Internet access (33.8 %); and (3) opportunities for voluntary inservice (43.9 %). Hardware and software were the most available resources with the accessibility of each rated at moderate or high by 73.6% of respondents. The only barrier a majority of respondents reported as having either moderate or high importance was "I have too many other responsibilities" (56.4%). The importance of not enough staff development opportunities was rated as moderate or high by 39.1% of those responding. Table 4 compares how subjects rated the accessibility and the value of each resource. The table shows mean ratings for accessibility and value, differences between the means, and the results of paired t-tests for each resource.

Table 4. Comparison of Mean Scores for Value versus Accessibility of Resources

Resource	Mean[1] (Accessibility)	(Value)	Difference	t-value
Computer hardware	3.088	3.404	.316	-2.70*
Computer software	3.007	3.228	.221	-2.63*
School administrator support	2.985	3.126	.141	-1.62
Help with hardware or software problems from other teachers	2.956	3.252	.296	-3.98*
Formal onsite technical assistance (such as a technology coordinator)	2.918	3.328	.410	-4.38*
Conversations among teachers about uses of computers	2.724	2.873	.149	-1.80
Computer-related district or school inservices	2.699	2.949	.250	-2.70*
Specified goals for teacher computer use in a School Improvement Plan	2.672	2.844	.172	-2.03*
Opportunities for voluntary inservice classes	2.466	2.985	.519	-5.35*
E-mail and Internet access	2.237	2.771	.534	-4.92*
Release time to observe good examples of computer use by other teachers	1.731	2.692	2.961	-8.97*

[1] 1=None 2=Low 3=Moderate 4=High

* $p < .05$

BEST COPY AVAILABLE

When asked why they thought teachers didn't use computers more, interview subjects mentioned fear, age, and lack of understanding and knowledge most often. Although few specifically stated training when asked this question, the importance of inservice was mentioned by most subjects at some time during the interviews.

Results of Multiple Linear Regression Analyses

Facilitators and barriers included in the regression analyses were available resources, perceived barriers, and selected individual characteristics. Individual characteristics included were age, gender, education level, years of computer experience, years of teaching experience, amount of prep time, and self-perception of expertise.

For each regression, free entry stepwise method ensured that only significant predictors remained in the regression. Dichotomous variables where one of the two responses received more than 90 percent of the total are not included. Tolerance protection of .30 was used to prevent excess multicollinearity. The mean value substitution for any missing items resulted in N=142 for all analyses.

Six of the variables entered the regression equation to provide a strong prediction (R^2 = .5247) of frequency of computer use (see Table 5). An individual's self-perception of expertise is the most powerful predictor. The negative beta for age suggests that younger teachers are associated with more frequent computer use. The negative beta for relevance indicates that disagreement with the statement "I can do my work as well without a computer" is associated with more frequent use. The negative beta for "no convenient access to a computer" indicates that a higher rating of the importance of this as a barrier is associated with more frequent computer use.

Table 5 Frequency of Use Regressed on Individual Characteristics, Facilitators, and Barriers

Variables in the equation	Beta	T	Sig T
Perception of expertise	.5448	7.504	<.0001
Availability of specific goals	.1295	2.113	.0364
Age	-.1732	-2.789	.0061
No access to a computer	-.2275	-3.427	.0008
Software too complicated	.2175	3.041	.0028
Relevance	-.1675	-2.543	.0121
R = .7244	R^2 = .5248	F = 24.85	Sig F = <.0001

To guard against the argument that frequency and relevance as separate measures is tautological, an additional regression analysis was performed omitting relevance as a predictor. Results show four predictors in this equation. The availability of specific computer goals did not enter when relevance was excluded. Perception of expertise is still the most powerful of the predictors. Table 6 shows the results of that analysis.

Table 6 Revised Frequency of Use Regressed on Individual Characteristics, Facilitators, and Barriers

Variables in the equation	Beta	T	Sig T
Perception of expertise	.5899	8.097	<.0001
Age	-.1978	-3.120	.0022
No access to a computer	-.2909	-4.465	<.0001
Software too complicated	.2065	2.810	.0057
R = .69959	R2 = .4894	F = 32.83 Sig F = <.0001	

Three of the facilitators and barriers provide a strong prediction (R^2 = .4469) of the essentiality of computer use (see Table 7). As with the prediction of frequency of use, an individual's self-perception of expertise is the most powerful predictor.

Table 7 Overall Essentiality of Computer Use Regressed on Individual Characteristics, Facilitators, and Barriers

Variables in the Equation	Beta	T	Sig T
Perception of expertise	.5215	6.958	<.0001
Relevance	-.3882	-5.782	<.0001
Software is too complicated	.1933	2.645	.0091
R = .676	R^2 = .457	F = 38.71	Sig F = <.0001

Once again to guard against the argument that essentiality and relevance as separate measures is tautological, an additional regression analysis was performed omitting relevance as a predictor. In this analysis, perception of expertise was still a significant predictor, but gender and the barrier of few other interested teachers also entered the equation. Table 8 shows the results of the analysis.

BEST COPY AVAILABLE

Table 8 Revised Overall Essentiality Regressed on Individual Characteristics, Facilitators, and Barriers

Variables in the equation	Beta	T	Sig T
Perception of expertise	.5868	8.583	< .0001
Gender	.2139	3.098	.0024
Few interested teachers	.1432	2.078	.0395

R = .6045 R^2 = .3654 F = 26.4904 Sig F = < .0001

Discussion and Implications

This study focused on teachers' perceptions of their computer practices in various aspects of their work. Its comprehensive conceptualization of *computer integration* was used to provide a clearer picture of the complexities of this construct.

Although a predominant pattern of dimensions did not emerge from the results, the various dimensions contributed to a more complete picture of the facets of teachers' professional use of computers. Teachers in the study generally perceived computer use as having a positive impact on their work. A majority felt they were more professional, more creative, better informed, and generally better educators as a result of their computer use. Results suggest that subjects have somewhat conventional vision regarding the possibilities for using the computer to support their day to day work. Creating more effective materials and saving time were rated as the most important reasons for using the computer.

Surprisingly, collegiality and communication with colleagues did not emerge as particularly important factors. Subjects did not view "I can communicate and collaborate with others" as an important reason for using the computer. A majority currently used the computer to create instructional materials, while few (11.3%) used it to communicate with colleagues, a use that might potentially ease the isolation of the profession. The low percent of computer use for communication might be attributed to the accessibility to e-mail and Internet access which was moderate or high for only 33.8% of the teachers who responded.

Results of this study reflect the dynamic nature of computer integration and raise further questions regarding how changes in accessible resources will alter the nature of teachers' computer integration, their reasons for using computers and their perceptions of how the computer influences their work. This is particularly evident in the area of using the ability of computer to access the Internet and to communicate with others. The teachers in this study had limited Internet and email access. As this access increases will it increase collegial communication and facilitate professional development? Will this access expand the vision of teachers of the ways in which the computer might support their workplace performance? These are among the questions that will provide insights into ways that teachers might more fully utilize computers to support their ongoing development as effective and professional educators.

References

Baker, E. L., Gearhart, M., & Herman, J. L. (1993). The Apple Classrooms of Tomorrow: The UCLA evaluation studies (CSE Technical Report No. 353). Los Angeles: Center for the Study of Evaluation, Graduate School of Education, University of California, Los Angeles.

Becker, H. J. (1994). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. Journal of Research on Computing in Education, 26(3), 291-321.

Carr, C. (1992). Performance support systems–the next step? Performance and Instruction, 31(5), 23-26.

Carrol, J. S. & Perin, C. (1994). How expectations about microcomputers influence their organizational consequences. In T. J. Allen & M. S. S. Morton (Eds.), Information technology and the corporations of the 1990's (pp. 346-367). New York: Oxford University Press.

Evans-Andris, M. (1995). An examination of computing styles among teachers in elementary schools. Educational Technology Research and Development, 43(2), 15-31.

Hadley, M. & Sheingold, K. (1993). Commonalties and distinctive patterns in teachers' integration of computers. American Journal of Education, 101(3), 261-315.

Hart, A. W. (1995). The impacts of mathematics and computer technology on the core assumptions and practices of teaching. In S. B. Bacharach & B. Mundell (Eds.), Images of schools: Structures and roles in organizational behavior (pp. 155-200). Thousand Oaks, CA: Corwin Press.

Marcinkiewicz, H. R. (1993-94). Computers and teachers: Factors influencing computer use in the classroom. Journal of Research on Computing in Education, 26(2), 220-235.

McLaughlin, M. (1993). What matters most in teachers' workplace context. In J. W. Little & M. W. McLaughlin (Eds.), Teachers' Work: Individuals, colleagues, and contexts (pp. 79-103). New York: Teachers College Press.

Moersch, C. (1995). Levels of technology implementation (LoTi): A framework for measuring classroom technology use. Learning and Leading with Technology, 23(3), 40-42.

Pasmore, W. A. (1988). Designing effective organizations: The sociotechnical systems perspective. New York: John Wiley & Sons.

Pelgrum, W. J., & Plomp, T. (1991). The use of computers in education worldwide. New York: Pergamon Press.

Reynolds, A. (1992). What is competent beginning teaching? A review of the literature. Review of Educational Research, 62(1), 1-35

Shedd, J. B. & Bacharach, S. B. (1991). Tangled hierarchies: Teachers as professionals and the management of schools. San Francisco: Jossey-Bass.

Trist, E. (1993). Pava's extension of sociotechnical theory to advanced information technologies. In E. Trist & H. Murray (Eds.), The social engagement of social science: A Tavistock anthology (pp. 662-673). Philadelphia: University of Pennsylvania Press.

Wilson, B. G., Hamilton, R., Teslow, J. L., & Cyr, T. A. (1994). Technology making a difference: The Peakview Elementary School study. Syracuse, NY: ERIC Clearinghouse on Information and Technology. (ERIC Document Reproduction Service No. ED 381 149)

Zammit, S. A. (1992). Factors facilitating or hindering the use of computers in schools. Educational Research, 34(1), 57-66.

Zuboff, S. (1988). In the age of the smart machine. New York: Basic Books.